

## THE RED RING NEMATODE AND ITS VECTORS<sup>1</sup>

R. M. Giblin-Davis<sup>2</sup>

**BACKGROUND:** Red ring nematode, Bursaphelenchus cocophilus (Cobb) Baujard (formerly Rhadinaphelenchus cocophilus) causes the red ring disease (RRD) of palms and is a very important palm pest in the Neotropics (6). Bursaphelenchus cocophilus parasitizes the palm weevil, Rhynchophorus palmarum L., which transmits it to the coconut palm, Cocos nucifera L., and the oil palm, Elaeis guineensis Jacquin (6). Research on the culture of this nematode suggests that it is an obligate plant-parasite. RRD of coconuts was first reported in 1905 in Trinidad. In 1918, Nowell reported that there was an association between the red ring disease and a nematode.

**LIFE CYCLE:** A schematic drawing of the association of B. cocophilus with its weevil and coconut hosts is presented in Figure 1. Adult R. palmarum females which are internally infested with B. cocophilus disperse to a healthy coconut palm and deposit the juvenile stage of the nematode during oviposition. Nematodes enter oviposition wounds, feed, and reproduce in the palm tissues, causing the death of the infected trees (1,2,4,6). The weevil larvae are parasitized by juveniles of B. cocophilus which persist in the insect through metamorphosis, apparently without molting, and appear to aggregate around the genital capsule of the adult weevil (4,6). The adult weevils emerge from their cocoons in the rotted palm and disperse to apparently healthy or stressed and dying palms, completing the life cycle.

**DISTRIBUTION AND ECONOMIC IMPORTANCE:** The range of R. palmarum apparently extends from the southern parts of California and Texas southward through Mexico into South America and eastward in the West Indies up to Cuba (2). The red ring nematode is co-distributed with R. palmarum in the lower Antilles, and Mexico southward into South America. Bursaphelenchus cocophilus has never been reported from the continental United States, Puerto Rico, Virgin Islands, or Hawaii.

**COCONUT SEEDNUT SUPPLY AND DEMAND IN FLORIDA:** Ornamental horticulturists in southern Florida have become interested in increasing production of coconut palms for use in Florida landscapes. Consumer demand is for lethal yellowing resistant coconut cultivars to replace the thousands of palms that were lost to this disease in recent decades. This mycoplasma-like organism (MLO) caused disease has almost eliminated the 'Jamaica Tall' cultivar of coconut in Jamaica, southeastern Florida, the Yucatan Peninsula, and Mexico, and continues to pose a threat to susceptible palms in the Western Hemisphere. The golden (= red), yellow, and green 'Malayan Dwarf' cultivars, and the 'Maypan' hybrid ('Malayan Dwarf' X 'Panama Tall') are thus far the only coconut types that have been investigated enough to warrant their recommendation as lethal yellowing resistant. Currently, there are two sources of certified seednut of 'Malayan Dwarf' and 'Maypan' coconuts in Florida. The Division of Forestry Seed Orchard in Miami which serves the replanting needs of park departments, and the Coconut Industry Board in Jamaica. These two sources, which provide insect,

---

<sup>1</sup>Florida Agricultural Experiment Stations Journal Series No. N-00228.

<sup>2</sup>Associate Professor, Ft. Lauderdale Research & Education Center, IFAS, University of Florida, 3205 College Ave., Ft. Lauderdale, FL 33314.

nematode, and virus free germplasm, are not enough to supply the increasing demands for inexpensive, quality-controlled coconut seednut for nurseries in southern Florida.

**PLANT PROTECTION AND QUARANTINE PROCEDURES:** The importation of foreign propagative materials into the United States is regulated by quarantine law Q-37. In light of problems with lethal yellowing, Q-37 was amended to prohibit the introduction of coconut palms or seednuts from foreign countries into the U.S. Currently, seednuts of C. nucifera entering the U.S. are certified to be 'Malayan Dwarf' or 'Maypan' cultivars from Jamaica which makes Jamaica the sole source for introduction of lethal yellowing-resistant seednuts from foreign sources.

**POTENTIAL THREAT OF RED RING DISEASE TO FLORIDA:** Esser (1) has suggested that RRD could easily be introduced into Florida from the Neotropics. There are two routes for the accidental introduction and establishment of the RRD complex in southern Florida via importation of seednuts. The first and likely route for introduction of the disease complex would be through the introduction of RRD-infested R. palmarum that had traveled undetected in a shipment of coconut seednuts. The second route could be through the introduction of a red ring nematode-infested coconut seednut.

Management to prevent the introduction of the RRD complex could be facilitated by: 1) fumigation of seednuts to kill hitchhiking weevils, 2) harvesting seednuts from areas that are certified free of red ring disease, and 3) use of the embryo rescue technique to avoid sending whole seednuts which could act as harborage for nematode-infested weevils.

R. palmarum is not currently distributed in the southeastern U.S. If this weevil could survive and reproduce in the southeast there is the question of what are its preferred hosts. Experimentally, red ring nematode-infested palm tissue causes the disease in a wide variety of palms. However, in nature the nematode is transmitted mainly to palms that are attractive to the weevils. For example, in Brazil, the red ring disease complex probably cycles through Oenocarpus distichus Mart. in the jungle. When oil palm is established in large plantations in these same areas and pruned, creating wounds that are attractive to R. palmarum, the red ring nematode is introduced into and can kill this palm species (7). Most observations of R. palmarum in oil palm suggest that R. palmarum cannot complete its life cycle in this palm host. This means that the red ring disease complex occurs in oil palm plantations because of attractive wounds caused by cultural practices. The disease complex is maintained in native palms in the area. In southern Florida, coconut palms are distributed from the Keys north to Lake Okeechobee. Obviously these palms would be good hosts in which to maintain the red ring disease complex. It has not been established whether Sabal palmetto (Walt.) Lodd. ex Schult. & Schult. f. and Phoenix canariensis Hortorum ex Chabaud which are widely distributed as ornamental palms in the southeastern U.S. would be good hosts for the red ring disease complex. The big thatch palm, S. blackburniana Glazeb. ex Schult. & Schult. f., the carat palm, Sabal sp., and Phoenix sp. have been reported as hosts of R. palmarum. Phoenix dactylifera and P. canariensis have been reported as hosts for the red ring nematode(1). The practice of transplanting mature S. palmetto and P. canariensis is known to predispose these palms to attack from R. cruentatus, which is endemic to the southeastern U.S.

Research concerning the vectors of RRD in Trinidad and Ecuador has demonstrated that the palm weevil, Dynamis borassi Fabricius in Ecuador can carry red ring nematodes through metamorphosis (5). This suggests that under certain circumstances D. borassi may also serve as a vector for the nematode. It also suggests that other members of

the genus Rhynchophorus, which are more closely related to R. palmarum than D. borassi, such as R. cruentatus, may be capable vectors for the red ring nematode. It must be emphasized that the most common hosts for R. cruentatus are S. palmetto and P. canariensis.

The second route for introduction of the RRD complex to southern Florida could be through the introduction of red ring nematode-infested seednuts. Fenwick and Mohammed (3) reviewed the literature on the potential for seednut infection by B. cocophilus. Early reports stated that red ring nematode could penetrate the husks of nearly mature fruits on wet soil and that large green fruits could be infested with nematodes by inoculating with infested fragments of stem tissue. Harvested immature coconut fruits have subsequently been shown to be suitable for sustaining the reproduction of the nematode for several weeks. Inoculation experiments showed that the nematodes could not infest trees from inoculated fruits on the palm, suggesting that the nematodes could not migrate through the dense tissue of the inflorescence to infest the stem or crown. Esser & Meredith (2), however, reported that on rare occasions red ring nematodes were recovered from the endosperm of immature coconut fruits. Most observations suggest that premature fruit drop occurs during red ring nematode infestations. RRD did not become established in coconut and/or oil palms originating from seednuts and/or seedlings artificially inoculated with B. cocophilus (3).

**CONCLUSION:** Regulatory personnel cannot "tempt fate" in decisions to exclude potential pests from the U.S., thus Q-37 prevents the importation of coconut seednuts from foreign countries into Florida. As I have outlined, the major risk to Florida for introducing RRD would be in importing red ring nematode-parasitized R. palmarum with seednuts from foreign sources. Efforts should be focused on providing cost effective embryo rescue techniques and facilities. Quality control could be easily accomplished and the chance introduction of nematodes or other diseases would be minimized by using the embryo rescue technique.

#### LITERATURE CITED:

1. Esser, R. P. 1969. Rhadinaphelenchus cocophilus a potential threat to Florida palms. Fla. Dept. Agric. & Consumer Serv., Div. Plant Ind., Nema. Circ. No. 9.
2. \_\_\_\_\_, and J. A. Meredith. 1987. Red ring nematode. Fla. Dept. Agric. & Consumer Serv., Div. Plant Ind., Nema. Circ. No. 141.
3. Fenwick, D. W., and S. Mohammed. 1964. Artificial infections of seednuts and young seedlings of the coconut palm with the red-ring nematode Rhadinaphelenchus cocophilus (Cobb). Nematologica 10:459-463.
4. Gerber, K., and R. M. Giblin-Davis. 1990. Association of the red ring nematode, Rhadinaphelenchus cocophilus, and other nematode species with Rhynchophorus palmarum (Coleoptera: Curculionidae). J. Nematol. 22:143-149.
5. \_\_\_\_\_, \_\_\_\_\_, and J. Escobar-Goyes. 1990. Association of the red ring nematode, Rhadinaphelenchus cocophilus, with weevils from Ecuador and Trinidad. Nematropica 20:39-49.
6. Griffith, R. 1987. Red ring disease of coconut palm. Plant Disease. 71:193-196.
7. Schuiling, M., and J. B. M. van Dinther. 1981. "Red ring disease" in the Paricatuba oilpalm estate, Para, Brazil. Z. ang. Ent. 91:154-169.

Contribution No. 414, Bureau of Nematology [Nema. Circ. #181]

This publication was issued at a cost of \$673.29 or \$0.20 per copy to provide information on proper recognition of plant pests. PI90T-40

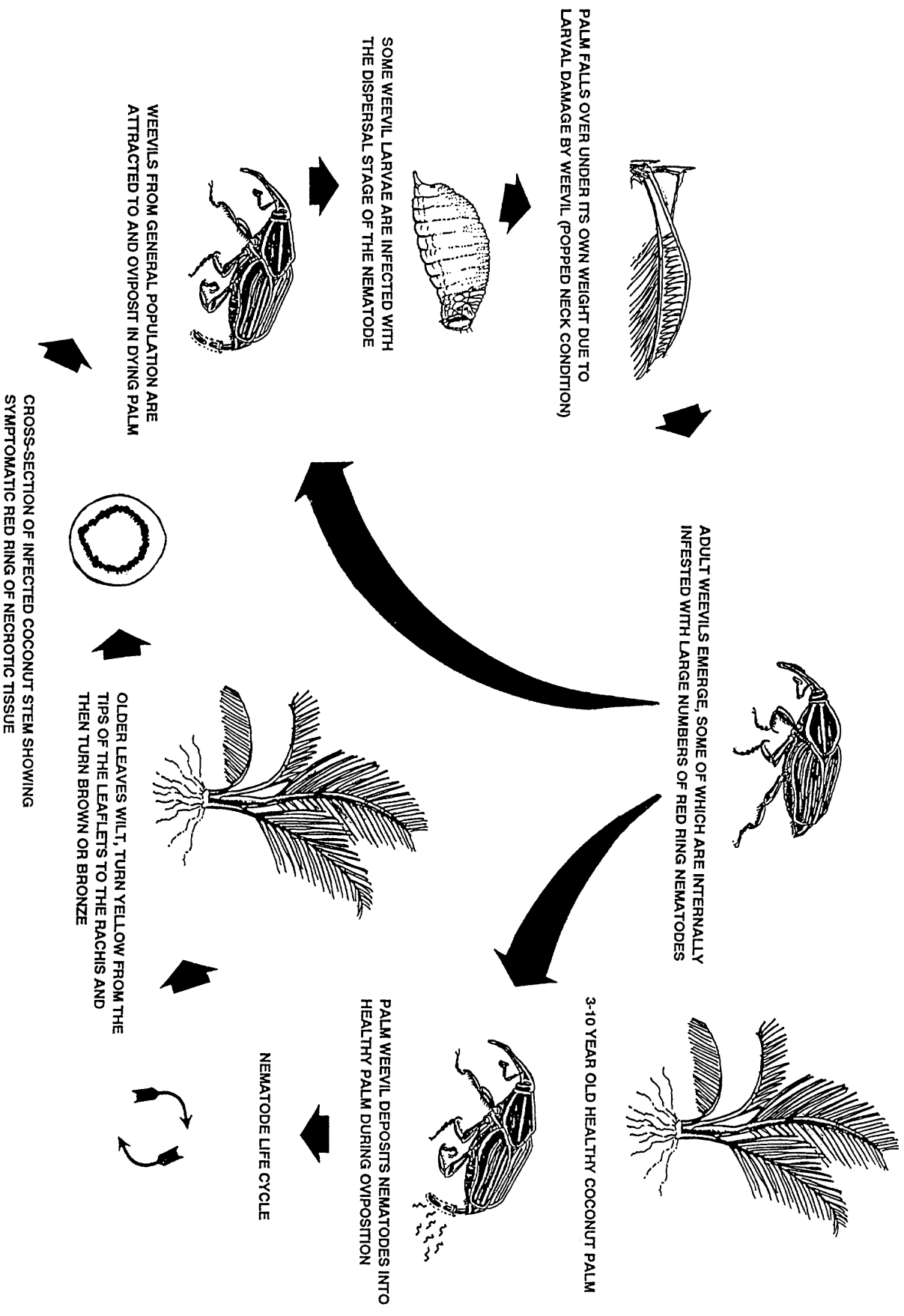


Fig. 1. Association of Bursaphelenchus cocophilus, the red ring nematode with its weevil, Rhynchophorus palmarum, and coconut hosts.